

## Claims

- [c1] 1. A method for controlling concurrent access of prefix encoded nodes in a hierarchically structured document comprising steps of:
- a. processing an explicit lock request on a node by determining ancestor nodes from said node,
  - b. deriving implicitly from said explicit lock request, a set of locks for said determined ancestor nodes,
  - c. comparing said derived set of implicit locks with existing lock modes for said determined ancestor nodes, and
  - d. granting or denying said explicit lock request on said node based on results of said comparing step.
- [c2] 2. A method for controlling concurrent access, as per claim 1, wherein said hierarchically structured document is an XML document.
- [c3] 3. A method for controlling concurrent access, as per claim 1, wherein said node is comprised of data and a node identifier (ID).
- [c4] 4. A method for controlling concurrent access, as per claim 3, wherein said explicit lock mode is any of: a

shared (S), update (U), or exclusive (X) lock mode.

- [c5] 5. A method for controlling concurrent access, as per claim 1, whereupon granting said explicit lock request, one or more of said implicitly derived locks are implicitly applied to said ancestor nodes.
- [c6] 6. A method for controlling concurrent access, as per claim 4, wherein said implicitly derived lock mode is any of: an intention-shared (IS), intention-exclusive (IX), or a shared, intention-exclusive lock (SIX) mode.
- [c7] 7. A method for controlling concurrent access, as per claim 6, wherein
- a. an explicit lock request on said node in lock mode S implicitly derives a set of locks in IS mode,
  - b. an explicit lock request on said node in lock mode X implicitly derives a set of locks in IX mode,
  - c. an explicit lock request on said node in lock mode IS implicitly derives a set of locks in IS mode,
  - d. an explicit lock request on said node in lock mode IX implicitly derives a set of locks in IX mode, and
  - e. an explicit lock request on said node in lock mode SIX implicitly derives a set of locks in SIX mode.
- [c8] 8. A method for controlling concurrent access, as per claim 7, wherein said lock request is denied if said com-

parison step results in incompatibility and granted otherwise; said comparison step results in compatibility between said existing and derived lock modes if lock request mode for said node is:

- a. IS and said ancestor nodes are locked in any existing mode of: IS, IX, S, or SIX,
  - b. IX and said ancestor nodes are locked in either existing mode of: IS or IX,
  - c. S and said ancestor nodes are locked in either existing mode of: IS or S,
  - d. SIX and said ancestor nodes are locked in existing mode of IS, and
  - e. X and said ancestor nodes are not currently locked;
- and

said comparison step results in incompatibility between said existing and derived lock modes, otherwise.

[c9] 9. A method for controlling concurrent access, as per claim 8, wherein said comparing step is facilitated by a logical data structure indicating existing lock information for each node; said logical data structure comprising logical lock tree nodes.

[c10] 10. A method for controlling concurrent access, as per claim 9, wherein said logical lock tree nodes are comprised of at least: a node ID field, a transaction ID field, and a lock mode field.

- [c11] 11. A method for controlling concurrent access, as per claim 10, whereupon granting a lock request, a logical lock tree node for said node is created and ID of said node is inserted into said logical lock tree node ID field, a transaction ID is inserted into said logical lock tree node transaction ID field, a lock mode is inserted into said logical lock tree node lock mode field; and if logical lock tree nodes exist for said ancestor nodes, adding either one or both of: a transaction ID to said logical lock tree node transaction ID fields and adding said lock mode to said logical lock tree node lock mode fields;  
else  
creating logical lock tree nodes for said ancestor nodes, inserting IDs of said ancestor nodes into said logical lock tree node ID fields, inserting a transaction ID into said logical lock tree node transaction ID fields, and inserting a lock mode into said logical lock tree node lock mode fields.
- [c12] 12. An article of manufacture comprising a computer usable medium having computer readable program code embodied therein which implements concurrent access control of prefix encoded nodes in a hierarchically structured document comprising modules implementing code for:

a. processing an explicit lock request on a node by determining ancestors nodes from said node,  
b. deriving from said explicit lock request, a set of implicit locks for said determined ancestor nodes,  
c. comparing said derived set of implicit locks with existing lock modes for said determined ancestor nodes,  
and  
granting or denying said explicit lock request on said node based on results of said comparing step.

[c13] 13. An article of manufacture for controlling concurrent access, as per claim 12, wherein said hierarchically structured document is an XML document.

[c14] 14. An article of manufacture for controlling concurrent access, as per claim 12, wherein said node is comprised of data and a node identifier (ID).

[c15] 15. An article of manufacture for controlling concurrent access, as per claim 12, wherein said explicit lock mode is any of: a shared (S), update (U), or exclusive (X) lock mode.

[c16] 16. An article of manufacture for controlling concurrent access, as per claim 15, wherein said implicit lock mode is any of: an intention-shared (IS), intention exclusive (IX), or a shared, intention-exclusive lock (SIX) mode.

- [c17] 17. An article of manufacture for controlling concurrent access, as per claim 16, wherein
- a. an explicit lock request on said node in lock mode S derives a set of implicit locks in IS mode,
  - b. an explicit lock request on said node in lock mode X derives a set of implicit locks in IX mode,
  - c. an explicit lock request on said node in lock mode IS derives a set of implicit locks in IS mode,
  - d. an explicit lock request on said node in lock mode IX derives a set of implicit locks in IX mode, and
  - e. an explicit lock request on said node in lock mode SIX derives a set of implicit locks in SIX mode to be applied to said determined ancestor nodes.
- [c18] 18. An article of manufacture for controlling concurrent access, as per claim 17, wherein said comparison step results in compatibility between said existing and derived lock modes if lock request mode for said node is:
- a. IS and said ancestor nodes are locked in any existing mode of: IS, IX, S, or SIX,
  - b. IX and said ancestor nodes are locked in either existing mode of: IS or IX,
  - c. S and said ancestor nodes are locked in either existing mode of: IS or S,
  - d. SIX and said ancestor nodes are locked in existing mode of IS, and

e. X and said ancestor nodes are not currently locked; otherwise, said comparison step results in incompatibility between said existing and derived lock modes.

- [c19] 19. A system for controlling concurrent access of prefix encoded nodes in a hierarchically structured document comprising:
- a. a processor receiving as input, an explicit lock request on a node and providing as output ancestors nodes determined from said node,
  - b. a converter receiving as input said explicit lock request and deriving as output a set of implicit locks for said output ancestor nodes,
  - c. a comparator comparing said derived set of implicit locks with existing lock modes for said output ancestor nodes, and
- a lock request grantor, granting or denying said explicit lock request on said node based on output of said comparator.

- [c20] 20. A method for controlling concurrent access of prefix encoded nodes in a hierarchically structured document comprising steps of:
- a. processing an explicit lock release on a node by determining ancestors nodes from said node; said explicit lock release requested by a transaction;

- b. deriving from said explicit lock release, a set of implicit lock modes for said determined ancestor nodes, and
- c. releasing locks on determined ancestor nodes corresponding to said derived implicit lock mode; said locks on determined ancestor nodes originally requested by said transaction.

[c21] 21. An article of manufacture comprising a computer usable medium having computer readable program code embodied therein which implements concurrent access control of prefix encoded nodes in a hierarchically structured document comprising modules executing:

- a. explicit lock request processing on a node by determining ancestor nodes from said node,
- b. implicit derivation of a set of locks for said determined ancestor nodes from said explicit lock request,
- c. a comparison of said derived set of implicit locks with existing lock modes for said determined ancestor nodes, and
- d. granting or denying said explicit lock request on said node based on results of said comparing step.